

MEMS Sensors

TDK launches SmartEdgeML™ to run ultra-low power machine learning models on a 6-axis IMU

- The SmartEdgeML solution allows users to build, test, tune, and deploy ML models at the sensor chip level
- SmartEdgeML includes: SmartMotion™ ICM-45686-S 6-axis motion sensor, SmartBug 2.0 evaluation kit, and Sensor Inference Framework (SIF) software, now available for download
- SmartBug 2.0 (MD-45688-ML) will be available February 1 to evaluate SIF with ICM-45686-S

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TDK Corporation (TSE:6762) announces the InvenSense SmartEdgeML™, an advanced edge ML solution enabling new possibilities for wearables, hearables, AR glasses, IoT, and other products that benefit from machine learning (ML) at the sensor chip level. SmartEdgeML is the first solution to generate and run machine learning models on a 2.5 x 3mm 6-axis motion sensor IMU at < 30 µA.

“TDK’s SmartEdgeML is a paradigm shift in edge machine learning, as it will allow developers, ODMs, and OEMs to implement ML-optimized motion sensor algorithms on an IMU sensor chip. This reduces the amount of raw data going to edge processors, which significantly improves device battery life, data privacy, and system latency,” said Sahil Choudhary, Director Motion Sensors and Software at InvenSense, a TDK Group company.

TDK also announces the availability of the InvenSense SmartBug 2.0 (MD-45686-ML), a multi-sensor wireless module consisting of the InvenSense ICM-45686-S IMU. This module works as the perfect evaluation system for users to get started with the InvenSense SIF and the ICM-45686-S IMU. The SIF is now available for download, while the MD-45686-ML and ICM-45686-S will be available at distributors by February 1, 2024.

There are three components of SmartEdgeML, which include:

- **SIF (sensor inference framework):** SIF, the software component of SmartEdgeML, is a complete machine learning framework by TDK, providing a one-stop-shop for users to collect IMU sensor data, select custom features, build ML models, test ML performance, deploy, and run those models on the ICM-45686-S IMU through the SmartBug 2.0. Tested examples include algorithms such as exercise classification (squats, jumping jacks, lateral raises, or push-ups) and wrist gesture classification (fight, turn, shake, or still).
- **ICM-45686-S IMU:** This is the hardware component of SmartEdgeML. The [SmartMotion ICM-45686-S](#) is a 2.5 x 3mm IMU from the TDK BalancedGyro™ family that enables ML decision tree models to be run on-chip at the lowest current consumption (< 30 µA). This new IMU provides premium temperature stability and vibration rejection, making it optimal for applications such as AR glasses, VR, OIS, drones, TWS, and robotics that need a combination of high-performance and ultra-low power machine learning algorithms.
- **SmartBug 2.0 (ML version):** MD-45686-ML is an all-in-one multi-sensor wireless module that comes with the ICM-45686-S 6-axis motion sensor and is compatible with the SIF. The small form factor and BLE + USB interface of SmartBug 2.0 allows users to get started quickly with SIF so they can move easily from data collection to building ML models, to deploying on the ICM-45686-S IMU. This is the go-to device for getting started with SmartEdgeML.

SmartEdgeML is being demonstrated at this week’s Consumer Electronics Show (CES) in Las Vegas from January 9-12, 2024. Come by the TDK booth #20521 in the CES Central Hall (LVCC) and look for the demo: “SmartEdgeML Machine Learning on a Chip” where you can build a machine learning algorithm on a 2.5*3 mm motion sensor in less than five minutes.

For more information about SmartEdgeML including the SmartBug 2.0, and to download the SIF software, visit invensense.tdk.com/smartedgempl or contact InvenSense Sales at sales.us@tdk.com.

Glossary

- Edge ML: machine learning at the chip level
- ML: machine learning
- IMU: inertial measurement unit
- IoT: Internet of Things
- SIF: sensor inference framework
- TWS: true wireless stereo

Main applications

- TWS, Hearables
- Wearables
- AR Glasses
- IoT

Main features and benefits

- Customization: Users can define and customize their own use case and build a motion sensor algorithm with SIF in less than five minutes (with AUTO mode). Users can also configure their custom sensor settings, filters and features based on their sensor algorithm requirements.
- Ownership: Users can own the data and test the ML model with their own dataset rather than depending on the sensor vendor for data collection.
- Time to market: SIF AUTO mode allows an ML beginner to build an ML model in five minutes. After the user collects data, the SIF takes care of the rest. Once the model/algorithm is ready and meets the performance criteria, TDK provides an integration guide to run the final algorithm on ICM-45686-S IMU on the user's system. This end-to-end ML solution on an IMU saves multiple months of algorithm effort.
- Ultra-Low Power: The SmartEdgeML solutions can run as low as <30 μ A. This low power allows the Edge processor device to sleep longer and process only smart data coming from the sensors, reducing battery drainage and MIPS cycles.

Key data

Type	Dimensions [mm]	Dimensions [mm]	Dimensions [mm]	Dimensions [mm]
MD-45686-S	36.6w x 50l x 18 mm	36.6	50	18

About TDK Corporation

TDK Corporation is a world leader in electronic solutions for the smart society based in Tokyo, Japan. Built on a foundation of material sciences mastery, TDK welcomes societal transformation by resolutely remaining at the forefront of technological evolution and deliberately "Attracting Tomorrow." It was established in 1935 to commercialize ferrite, a key material in electronic and magnetic products. TDK's comprehensive, innovation-driven portfolio features passive components such as ceramic, aluminum electrolytic and film capacitors, as well as magnetics, high-frequency, and piezo and protection devices. The product spectrum also includes sensors and sensor systems such as temperature and pressure, magnetic, and MEMS sensors. In addition, TDK provides power supplies and energy devices, magnetic heads and more. These products are marketed under the product brands TDK, EPCOS, InvenSense, Micronas, Tronics and TDK-Lambda. TDK focuses on demanding markets in automotive, industrial and consumer electronics, and information and communication technology. The company has a network of design and manufacturing locations and sales offices in Asia, Europe, and in North and South America. In fiscal 2023, TDK posted total sales of USD 16.1 billion and employed about 103,000 people worldwide.

About InvenSense

InvenSense, a TDK Group company, is a world-leading provider of Sensing Solutions. InvenSense's vision of Sensing Everything® targets the consumer electronics and industrial areas with integrated Motion, Sound, Pressure, and Ultrasonic solutions. InvenSense's solutions combine MEMS (micro electrical mechanical systems) sensors, such as accelerometers, gyroscopes, compasses, microphones, barometric pressure sensors, and ultrasonic time-of-flight sensors with proprietary algorithms and firmware that intelligently process, synthesize, and calibrate the output of sensors, maximizing performance and accuracy. InvenSense's motion tracking, ultrasonic, audio, fingerprint, location platforms and services can be found in Mobile, Wearables, Smart Home, Industrial, Automotive, IoT, Robotics, and many more types of products. InvenSense became part of the MEMS Sensors Business Group within the Sensor Systems Business Company of TDK Corporation in 2017. In April of 2022, Chirp Microsystems formally merged with InvenSense. InvenSense is headquartered in San Jose, California and has offices worldwide.

You can download this text and associated images from <https://invensense.tdk.com/news-media/tdk-launches-smartedgeml-to-run-ultra-low-power-machine-learning-models-on-a-6-axis-imu>.

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